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ABSTRACT

An exploration of the potential of telecommunications to serve the needs of Arizona for place- and time-flexible learning is presented as one working paper in the final report of the Arizona Board of Regents' Task Force on Excellence, Efficiency and Competitiveness. The study looks at the capability of a statewide network to serve both instructional outreach and data needs of an off-campus clientele and describes a proposed structure for the planning and operation of a statewide telecommunications network. Seven sections focus on the following: Arizona's need for extended and expanded learning and information services; development of a statewide telecommunications network; synthesis of a statewide network; organization for delivery of distance learning services; Arizona Educational Telecommunications Cooperative (with its goals and tasks listed); operation of the educational telecommunications network; and a proposed educational telecommunication network. Recommendations include: the Cooperative should seek resources to conduct an experiment on the use of satellite telecommunication for statewide service to schools; the Cooperative should devise a coordinated program of expanded offerings to rural Arizona using existing telecommunications capability; and the Cooperative should develop plans for a land-based microwave system that would provide links between the three public universities and the rural areas of the state. (SM)

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OPPORTUNITIES FOR TELECOMMUNICATION FOR UNIVERSITY OUTREACH IN ARIZONA

ROBERT MACVICAR

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INTRODUCTION

During all of recorded history, formal and informal teaching and learning have been conducted by teacher and student in close contact, through voice and demonstration heard and seen by the learner. The development of writing added a major dimension, making possible the recording of the "lecture" by the teacher in the form of a book and by the student in the form of lecture notes. This ancient process is still the dominant mode of instruction in school and college classrooms worldwide. Its very persistence through the centuries is indicative of its general acceptance and success.

There are, however, two severe limitations to the system. It requires that both the teacher and the student be present in the same place and at the same time. Only through the invention of communications systems such as the telephone, radio, and television, and such devices as teleconferencing bridges, microwave and fiber optic cable transmission components, satellites, computers, modems, and video-tape-recorders has the possibility of extended (over-distance) and expanded (over-time) learning become practical. Collectively, this extended learning process and its accompanying telecommunications technology is referred to as "telecommunications."

A significant portion of Arizona's population is remote from the campuses of the universities and, hence, could benefit from the availability of "distance learning" through the use of telecommunications, including video classes in real time. The urban population, moreover, often finds it impossible to take advantage of on-campus instruction because of employment and the resulting scheduling conflicts. This population can also be served by telecommunications through broadcasting video lectures at convenient times or by recording them for later replay.

The Telecommunications Division of the Arizona Department of Administration is creating a statewide network capable of serving the voice and data transmission needs of all the state agencies (including the state universities). The ultimate goal

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is to provide modern, high-quality capability to each county seat and major state installation. With appropriate design of this network, expansion to provide greater telecommunication capability to the three universities (and to the community colleges as well) at marginal additional cost is a very real possibility.

This working paper will explore the potential of telecommunications to serve the needs of Arizona for both place- and time-flexible learning. The capability of a statewide network to serve both instructional out-reach and data needs of an off-campus clientele will be presented.

Finally, the paper will describe a proposed structure for the planning and operation of a state-wide telecommunications network.

ARIZONA'S NEED FOR EXTENDED AND EXPANDED LEARNING AND INFORMATION SERVICES

Arizona is composed of two populations: one is located in two large metropolitan areas and comprises nearly 80 percent of the state's total and the remaining population is widely dispersed over the rest of the state. At present, the urban population is served by on-campus programs in Tempe, Phoenix, and Tucson. Both of the universities in the Phoenix and Tucson metropolitan areas offer upper division and graduate courses off-campus. Northern Arizona University offers off-campus classes in North Phoenix. The west campus of Arizona State University is currently serving 3,000 students (Spring Semester, 1988); it will complete the first phase of its permanent campus in Glendale within the next five years.

There are a number of independent and proprietary college level institutions in Phoenix. Grand Canyon College, located on West Indian School Road, serves an undergraduate population of 1,700. There are several proprietary institutions, all located in Phoenix, that provide baccalaureate and master's level programs. The American Graduate School of International Management offers a specialized master's degree, primarily to a full-time student body. In addition, there are a significant number of out-of-state public, independent and proprietary post-secondary institutions offering courses and special programs in the two metropolitan areas.

Each metropolitan area also has a community college "system" that offers lower division and non-credit programs in a wide range of specializations. These serve the full-time and part-time student and have extensive late-afternoon and evening offerings. While neither community college district has done an extensive survey of needs for the level of service they offer, both are highly responsive to the expressed needs of employees of the regions they serve. As will be described in detail in a later section, both have sought to increase the availability of their programs through the use of telecommunications. Maricopa Community College District has an ambitious plan to expand an already substantial capability to originate and broadcast courses via television.

No extensive needs assessment for collegiate level programs in the non-metropolitan areas of the state has been undertaken. Based on the experience of Northern Arizona University, which has attempted to serve the non-urban areas of the state, there appears to be a substantial unmet need in locations so small or so isolated that it has been impractical to serve them. For example, in a recent six month

period, Northern Arizona University was forced to cancel 62 graduate classes and 25 undergraduate classes for which there was insufficient enrollment to justify the cost of providing on-site instruction. These were courses for which adequate demand had been forecast. On-campus pressures have also limited the offering of courses and programs for which there is demand: business administration, accounting, computer science, engineering and nursing. These are components of higher education most likely to benefit small business and industry outside the two major metropolitan areas.

Increasingly, professional licensure is dependent for its renewal on demonstrated involvement in continuing education. Other occupational clusters also need exposure to current trends in order to maintain the competence of their members. Interruption of the regular schedule of these persons to travel to seminars or similar events at a central location represent a significant personal and organizational cost.

Using conventional techniques, however, requires the creation of an audience of such size as to justify the cost of preparing for and delivering the program. As a result, few programs are available during times and at places easily accessible to rural area practitioners. Collectively, this is a very substantial audience that is currently underserved by current efforts of the universities. This is particularly the case for those persons in rural Arizona.

It is even more difficult to measure the potential demand for "information services." Increasingly, access to data banks and other information retrieval services is essential to successful practice in many professional and technical specialties. Advances in technology may be expected to impact not only current users of this class of services but an increasing segment of the work force. The currently available Arizona Resource Services in Tucson served a total of 3,170 requests in 1986-87. Demands for present materials also give some indication of demand. The Arizona Inter-Library Loan Center in Phoenix processed over 45,000 requests for inter-library loan requests in the past fiscal year.

In addition to the needs of the public for educational service, the availability of a quality network interconnecting the three universities, the community colleges and their respective governing board offices could be useful in many ways. The capacity to transmit data for various purposes, administrative and research, among the components of the post-secondary complex would be desirable. A super-computing capability should be available to each of the university campuses and linkage to a Arizona computer and to national supercomputing centers via existing networks will be essential in maintaining the quality of the scientific and engineering research programs.

The inter-institutional sharing of scarce resources, personnel or technical capability through telecommunications can enhance quality. The expense of travel, both in direct costs and the more significant cost of lost time, can be avoided by use of audio tele-conferencing. When these conferees know each other reasonably well, meetings held by teleconferencing tend to be more productive than face-to-face contact. Faculty with unusual skills or unique specialties can be shared by more than one audience via telecommunication. The most desirable

mode is two-way video, two-way audio, which with appropriate equipment and planning might serve multiple sites. Distinguished scholars visiting one campus can become accessible to one or more other campuses via a telecommunication linkage. The need to enhance quality while making more efficient use of personnel is difficult to quantify but it clearly exists.

Although this document focuses on Arizona's needs for the services provided by the postsecondary segment, the K - 12 component also has needs that can be met via telecommunications. All schools can enrich their offerings by special programming delivered via television. Small rural high schools that cannot afford to offer a full range of college preparatory courses may be able to do so via telecommunications.

Through the use of telecommunications, individuals place-bound by distance, demands of employment, incarceration, or handicap can be provided educational services not now available. Business and industrial organizations and their employees can be served with programming tailored to their needs, regardless of location. Educational and governmental entities can exchange data more efficiently than is currently the case. Better use can be made of the times and talents of faculty and administrators of the post-secondary institutions. Elementary and secondary schools can improve the quality and extent of their curricula. Research can be enhanced through greater accessibility to data bases and to super-computing capability. These needs, and others not yet clearly identified, can be efficiently and effectively served by a modern, flexible and expandable telecommunication network.

DEVELOPMENT OF A STATE-WIDE TELECOMMUNICATIONS NETWORK

Fragments of a statewide telecommunications network exist in Arizona, and a major expansion of the Department of Administration's voice and data network is in the late planning stages. If current plans are carried out, the major "backbone" of this network will be advertised for construction by late 1988. With appropriate planning, a comprehensive telecommunications system to serve the needs of all levels of education can be created at minimal cost. An inventory of currently available elements is presented below.

RADIO

Radio was the first of the telecommunications technologies to find broad use for "extended learning." As a media it is limited essentially to one-way audio and hence has not been used extensively except for "enrichment" of the curricula of the elementary and secondary schools. The University of Arizona and Northern Arizona University operate FM radio stations, both affiliated with National Public Radio. A limited amount of their on-the-air time during normal school hours is used to provide enrichment components. Rio Salado Community College also operates an FM station affiliated with National Public Radio.

TELECONFERENCE

This two-way audio technology can use the institution's own capabilities (as is the case at Northern Pioneer College in Navajo County) or leased-line or dial-up commercial telephone circuits. This technology has the advantage that the instructor and the students (who may be located at multiple sites) may

communicate with each other. This technology also permits the scheduling of meetings without the necessity of travel. Several of the community colleges own their own "bridges" for making the necessary inter-connections to all the locations involved in the process and others are planning to acquire them. These linkages may also be used for student advisement and registration.

It is possible to augment the voice transmission by graphics transmitted over the same interconnection from a central source. Teachers may, by this means, enhance written material supplied by mail or other means of distribution. Teleconferencing can also supplement by group discussion the distance learning provided by video-cassettes or programmed learning techniques.

The availability of a statewide and state-operated telecommunications network for voice and data transmission will enhance the opportunities to make more effective use of teleconferencing. When supplemented with graphical presentations and, as will be discussed later, computer technology, this mode of instruction becomes highly effective. The state-wide network should plan for expansion of this type of usage, particularly during the periods of minimal usage by state agencies from 5:00 p.m. to 8:00 a.m. In the optimum situation, every resident of Arizona would be able to use a local telephone call to access a range of distance learning opportunities.

COMPUTERS

The personal computer is becoming increasingly a means for instruction and learning. When combined with telecommunication linkages via an appropriate network, many of the advantages of teleconferencing can be experienced without the necessity of simultaneous presence of teacher and learner. The "electronic bulletin board" becomes a device through which the teacher communicates timely information to the class. The students may, in turn, use "electronic mail" to communicate with the teacher and have the teacher respond. When appropriate, the response may be added to the "bulletin board" for all the students to read. As faculty and students become more familiar with this technology and more comfortable with the computer as a communications device, it may be expected that this type of "extended learning" will increase.

The necessity for a good tele-communications network is self-evident if full use is to be made of this technology.

TELEVISION

Of all of the modalities for distance learning, television provides the best resemblance to the traditional classroom. The teacher can be seen and heard, and demonstrations can be displayed (often in a far superior fashion than is possible in the traditional classroom). Moreover, responses can be elicited from the students if two-way audio is available. Two-way video also permits the teacher to observe student responses at the distant site.

VIDEO CASSETTE

Of all of the means of using video for distance learning, the use of video cassette is the most flexible and least costly. Many video cassette packages are available from commercial and non-profit sources. Locally produced packages may be as simple as recording

an actual class with a fixed camera or a camera operated by the teacher. Whatever the source, the advantage to the student is time and place flexibility. The advantage to the college or university is relatively low cost if the number of users is substantial. A significant disadvantage is the delay in receiving feed-back to questions from the instructor, although time may be reduced through use of electronic mail. Also, video cassette courses may be supplemented by periodic visitation to the remote site by the instructor. Teleconferencing at scheduled times also permits the students to interact with the instructor and with each other.

OPEN-CIRCUIT TELEVISION

Open-circuit broadcasting of educational materials via VHF or UHF channels has been employed for many years. This may be supplemental material or entire courses. The instruction can be in real time or be a delayed broadcast of a pre-recorded class session. It can be supplemented by two way audio if the facilities are available.

The public broadcasting station located in Tucson, KUAT, broadcasts 30 programs per week for the Arizona Schools Services through Educational Technology (ASSET) and six nationally-produced video telecourses offered by Pima Community College for undergraduate credit. The public station in Tempe, KAET, broadcasts nine video-telecourses for Arizona State University credit and six for Rio Salado Community College of the Maricopa Community College District. KAET-TV also broadcasts in-school video programming to K-12 schools that receive its signal. Two of the station's early morning hours are reserved for broadcasting for videotaping and play-back later. Both of these stations have some time that could be used for broadcasting during the early morning hours when the stations are off the air. Programs could be received at the time of broadcast or recorded by the student for later viewing. One commercial station in Phoenix (KTVK, Channel 3) donates two hours of early morning time for broadcast of courses provided by the Maricopa Community College District.

INSTRUCTIONAL TELEVISION FIXED SERVICES (ITFS)

This mode of delivery involves the use of channels in the ultra-high frequency range reserved by the Federal Communication Commission for educational use. These require relatively low power transmitters for line-of-sight reception. Both the University of Arizona and Arizona State University use ITFS broadcasting to service business and industrial firms that contract for courses to be viewed on the company's site, after and during regular working hours.

The relatively short range of the broadcast signal of an ITFS station is a limitation, but its relatively low installation costs encourage its use. When combined with reverse audio capability, it is an attractive alternative for expansion of programming into relatively high density markets. Cooperation between the university segment and the community colleges will be essential if upper division and graduate courses are to be delivered outside the metropolitan areas by this means.

CABLE TELEVISION

Many areas of Arizona are served by cable and, when available, many households and other users are connected to the cable. As a public

service, some cable companies provide channels which became available for transmitting signals provided by colleges and universities. A number of community colleges and the public universities provide instructional material to the cable head-end for transmission to those who can receive the signal. Unfortunately, the number of cable operators is so numerous that it is difficult to develop agreements with most of them. Some significant fraction of the rural public, moreover, is located outside the area served by cable. Despite these limitations, the availability of Instructional Television Fixed Services channels in several locations makes it possible for each cable company to receive the signal and include it in its offering on the cable.

SATELLITE COMMUNICATION

In some respects, communication by a satellite transponder is superior to the conventional broadcast range of a VHF, UHF or ITFS station. This signal can originate at any "up-link" site and be received by any organization or individual who has a "down-link" receiver. Currently only Arizona State University and the University of Arizona have "up-link" capability. Many of the community colleges and Northern Arizona University have "down-link" receivers. The universities with ITFS capacity can rebroadcast material received via satellite to the respective receiving sites. When other institutions install ITFS capability, they could use this as a means of dissemination to those who have access to the ITFS signal.

In the past, the relatively high cost of transponder rental rendered satellite transmission less attractive than conventional means using microwave or fiber optic cable. If, however, the audience is sufficiently large or if subsidy is provided by the user, satellite communication is advantageous because it "blankets" an entire region with the signal. It is this wide-spread use that makes satellite transmission practical for engineering courses prepared at two of the Arizona universities for National Technological University, a consortium offering degree programs via telecommunications nation-wide. It is anticipated, moreover, that transponder rental costs may decrease in the highly competitive telecommunications market. Several states are using satellite transmission to serve public schools. Cooperation between agencies serving schools and universities serving a statewide or regional audience has potential for the low population density states of the West, including Arizona.

Satellite transmission is also used to provide national teleconferences to Arizona audiences. Several of these national conferences focusing on topics of interest are made available each year to Arizona audiences which gather at an appropriate location to participate. Many of these teleconferences are provided with two way audio capacity.

SYNTHESIS OF A STATE-WIDE NETWORK

From the preceding paragraphs, it is obvious that there are major resources currently available in the area of telecommunications and that more are likely to be added in the near future. What is missing is a vision of what a statewide comprehensive network could do to serve Arizonans, urban and rural citizens alike. What is needed is a mechanism for planning and implementing an orderly sequence of steps that would elicit the support of the

state to provide the necessary resources to create a network, one that would expand and extend educational services statewide. In the material which follows, a mechanism will be presented for the organizational structure and an outline of a possible first phase for the creation of the Arizona Telecommunications Network.

ORGANIZATION FOR DELIVERY OF DISTANCE LEARNING SERVICES

The introduction of technology and particularly telecommunications into the provision of educational services at a distance creates numerous problems for the providers of these services that have not heretofore been confronted. In Arizona most of these problems will be solved by cooperative action among the public educational entities and the state agency that manages the telecommunications system. Stimulated by the proposed expansion of the state telecommunications network, representatives of the principal providers of service and the State Department of Administration began a series of meetings in the Fall, 1987. As a result of these discussions, a proposed organizational structure has emerged that, if implemented, provides for planning a statewide telecommunications network and coordinates the offerings of the various elements that would use the network to deliver educational services.

ARIZONA EDUCATIONAL TELECOMMUNICATIONS COOPERATIVE

The mission of the Cooperative is to assist the public educational entities in the fulfillment of their teaching, research, community service and administrative functions through cooperative planning, development and use of telecommunication systems and services. The planning group proposed the following set of goals for the Cooperative:

- Encourage planning and policy development by state education institutions, boards, accrediting agencies, and the state executive and legislature to develop and implement state policies that direct how learning technologies are to be best integrated and funded at institutional and system levels.

- Facilitate the development of administrative, academic, research and student service infrastructures in individual educational entities that will enable advantageous use of telecommunications systems and services.

- Establish planning guidelines for the development of individual entity telecommunications master plans to achieve compatibility in form and nomenclature.

- Establish appropriate common technical and operating standards for telecommunications equipment and service levels in order to facilitate interconnectability of systems and services.

- Encourage educational entities to develop telecommunications system and service plans that are consistent with master planning guidelines; and to file a copy of such plans with the Arizona Educational Telecommunications Cooperative.

- Coordinate the development of a state educational telecommunications master plan which accommodates the needs and goals identified by Arizona

public educational entities and gives direction to technical compatibility and interconnection of potentially shareable systems.

- Facilitate access to shareable telecommunications systems and services through development and distribution of a resources guide including access criteria/policies, procedures and user fees; and, where appropriate, work with operation centers in order to facilitate interagency sharing of technology systems.

The following are illustrative tasks that the Cooperative may need to undertake in order to achieve its goals. It will identify specific activities that should be facilitated and encouraged among those educational entities that develop, operate, and seek to share public telecommunication systems and services.

- Gather and disseminate appropriate information to individuals at the several participant levels and to prospective participants.

- Coordinate/facilitate collaborative efforts in research such as needs assessment and evaluation of programs and projects.

- Coordinate/facilitate cooperative funding initiatives ranging from project gifts/grants to general legislative support.

- Coordinate/facilitate joint development of educational programming such as courses of instruction, seminars, conferences, and community services.

- Carry out liaison and coordinate cooperative projects with other Arizona entities and multi-state organizations such as WICHE.

- Where appropriate, coordinate/facilitate group buying of software and hardware resources.

- Where appropriate, coordinate the operation of networking centers to facilitate shared use of inter-connectable systems.

Several different models for the organization of the Cooperative were considered by the ad hoc group and a structure is proposed:

- Membership in the cooperative is composed of public educational institutions and entities which choose to affiliate and the Department of Administration (ex-officio).

- Other educational entities, public or private, may participate on the Councils of the Cooperative.

- Governance of the Cooperative is vested in a Board of Directors consisting of the CEO of each member institution or a designated representative.

- An Executive Committee, appointed annually by the Board of Directors, will oversee the operations of the Cooperative. Its membership will reflect the composition of the Board of Directors and a Board member will serve as its chair. It will have several subcommittees as may be determined appropriate by the Board. To deal with various aspects of the operation of the Cooperative, the members will nominate, as may be appropriate, persons to serve on Councils and ad hoc Task Forces created by the Board. These

elements of the organization enable the members to share information, ideas, experience and expertise; propose and carry out studies; develop plans and recommend actions to the Executive Committee. The Chair of a Council or Task Force is appointed by the Board from the membership of the Executive Committee.

- The Secretariat of the Board and its Executive Committee and Councils could be provided from the staff of the Board of Regents.

The functions assigned to each element of the organization in its initial development are as follows:

- The Board of Directors provides policy direction for the Cooperative and has the responsibility for approving the budget of the Cooperative and for seeking funding for the activities of the organization.

- The Executive Committee serves as the operational component and prepares the agenda for the Board meetings. The committee and ad hoc Task Forces make their recommendations to the Executive Committee.

- Initially, some Councils will operate in the area of technology systems: Telephones; Broadband Media; and Data/Computers; and other Councils will operate in the area of services: Academic Policy; Distance Learning; Administrative Users; Research Users; and Community Service Users. Additional Councils and/or ad hoc Task Forces will be organized as required. Such ad hoc Task Forces may be organized from among participants in two or more Councils to deal with matters that require cooperative attention from several points of view; e.g., systems, policy, users, etc. Other Task Forces may be organized to deal with short-term issues or opportunities that do not fall within the purview of existing Councils.

- The Secretariat of the Cooperative will include a staff officer of the Arizona Board of Regents and will, with appropriate other personnel, provide support services to the Board of Directors, the Executive Committee, the Councils, and the ad hoc Task Forces.

OPERATION OF THE EDUCATIONAL TELECOMMUNICATION NETWORK

Experience in other states and the advice of consultants strongly support the view that the technical support services could be provided a single state-wide agency. The planning for and coordination of the program aspects of the service to be provided by the respective educational elements seem best handled by a consortium, i.e., the Cooperative.

Responsibility for the voice and data transmission for state agencies is vested in the Telecommunications Division of the Department of Administration of the State of Arizona. It would be potentially feasible to create another statewide agency to deal with educational telecommunications. Such duplication, however, would not appear to be justifiable on a cost-effective basis. Duplication of towers and buildings as transmission sites for a second microwave system can be avoided. With proper advanced planning and construction, one complex would handle several transmission capabilities. Operational costs of engineers and

maintenance personnel, equipment to reach the transmission sites, road maintenance and other essential functions can be minimized. Redundancy to the state system can be provided by the educational system and used in an emergency.

Details on the financing of the added operational costs for the educational telecommunications network must be agreed upon. It should be recognized that the added cost for additional networks on the same physical structure is marginal. Use of the main state network after normal business hours also represents a marginal cost and the cost-recovery charges should reflect this fact.

Periodic reports on the operation of the network will be made to the users, including the members of the cooperative to the respective Boards, and to the Executive and Legislative branches of government.

A PROPOSED EDUCATIONAL TELECOMMUNICATION NETWORK

Given the circumstances existent in Arizona, the use of a variety of "distance learning" strategies needs to be pursued, using whenever feasible, the present resources of the universities and the state. A key element in this development is the creation of a full-time, two channel microwave link between Winslow in the Northeast, Kingman in the Northwest, Flagstaff, Phoenix, Tucson, Douglas in the Southeast and Yuma in the Southwest. Included in the system would be NAU, ASU (Tempe), ASU-WEST, the Maricopa Agricultural Center of the U of A, U of A (Tucson), the Sierra Vista and Yuma Centers, and the community colleges located along the path. It would be feasible to construct this network in several steps over a period of time (Figure 1).

The current plans of the State Department of Administration are to create a voice/data microwave network serving most of the same population by 1989. Initially (Phase 1) only the Winslow to Douglas "backbone" would be served by land-based microwave technology. The remainder of the state would be connected to the "backbone" of the network by leased telephone circuits. Presumably economy would dictate that the Educational Telecommunication Network would make great use of the facilities created for voice/data linkages. Present demands for voice/data do not justify creating a microwave link to either Kingman or Yuma for this purpose alone. If educational usage justified the microwave linkage, the voice/data network could replace its telephone circuits on these segments of the network.

In addition to the microwave linkages, it is proposed to provide an Interactive Television Fixed System (ITFS) in each community along the path of the network to deliver courses and other educational material to schools, other multi-user sites and cable systems. As technology improves the quality of reception and reduces its cost, households may be equipped to receive the signal.

Through cooperation with the community colleges' microwave telecommunication systems, university programs could be broadcast when that system was not normally in use. If demand for services justified, the ETN could be expanded using existing microwave towers. The University of Arizona currently has a microwave link to Fort Huachuca and proposes to expand it to the Cochise Community College campus in Sierra

Vista. This expanded network would give an estimated 90 percent of the population of Arizona access to off-campus instruction and other educational services in proximity to their work stations or their homes. If all of the community colleges subsequently developed a system to serve their service area and if the ETN were expanded to reach Eastern Arizona College in Thatcher, only a few sparsely populated areas would be beyond access to service via microwave and ITFS.

A diagram of the Educational Microwave Network and that of the Department of Administration is presented in Figure 1, at the end of this report. While detailed planning for and funding of construction of the ETN is progressing, it is proposed that transponder time be leased to provide educational services to schools, college courses and other programming to audiences that cannot be reached by the microwave linkages proposed in Phase 1. This would augment the ASSET program for schools and provide convenient scheduling of courses that might in certain locations be interactive via telephone circuits provided by the state voice/data network.

RECOMMENDATIONS

- The appropriate governing boards and state agencies should authorize the organization of the Arizona Telecommunications Cooperative as a means of facilitating planning for and delivery of an expanded opportunity for "distance learning" at the elementary, secondary and post-secondary levels. A structure for the Cooperative is proposed.

- The Cooperative should undertake studies to determine the prospective need for distance learning within Arizona and develop plans for providing those services that appear to be economically feasible.

- Using existing or soon to become available capability for telecommunications, the Cooperative should devise a coordinated program of expanded offerings to rural Arizona.

- The Cooperative should develop plans for a land-based microwave system that would provide linkage between the three public universities and the rural areas of the state..

- The Cooperative should seek resources to conduct an experiment on the use of satellite telecommunication to provide a statewide service to schools and access to university courses and information services.

- The Board of Regents and the Board of Directors for Community Colleges should jointly address the issue of multiple use of telecommunication courses produced by their respective institutions and develop policies protecting the interests of the public, the sponsoring college or university, and the faculty.

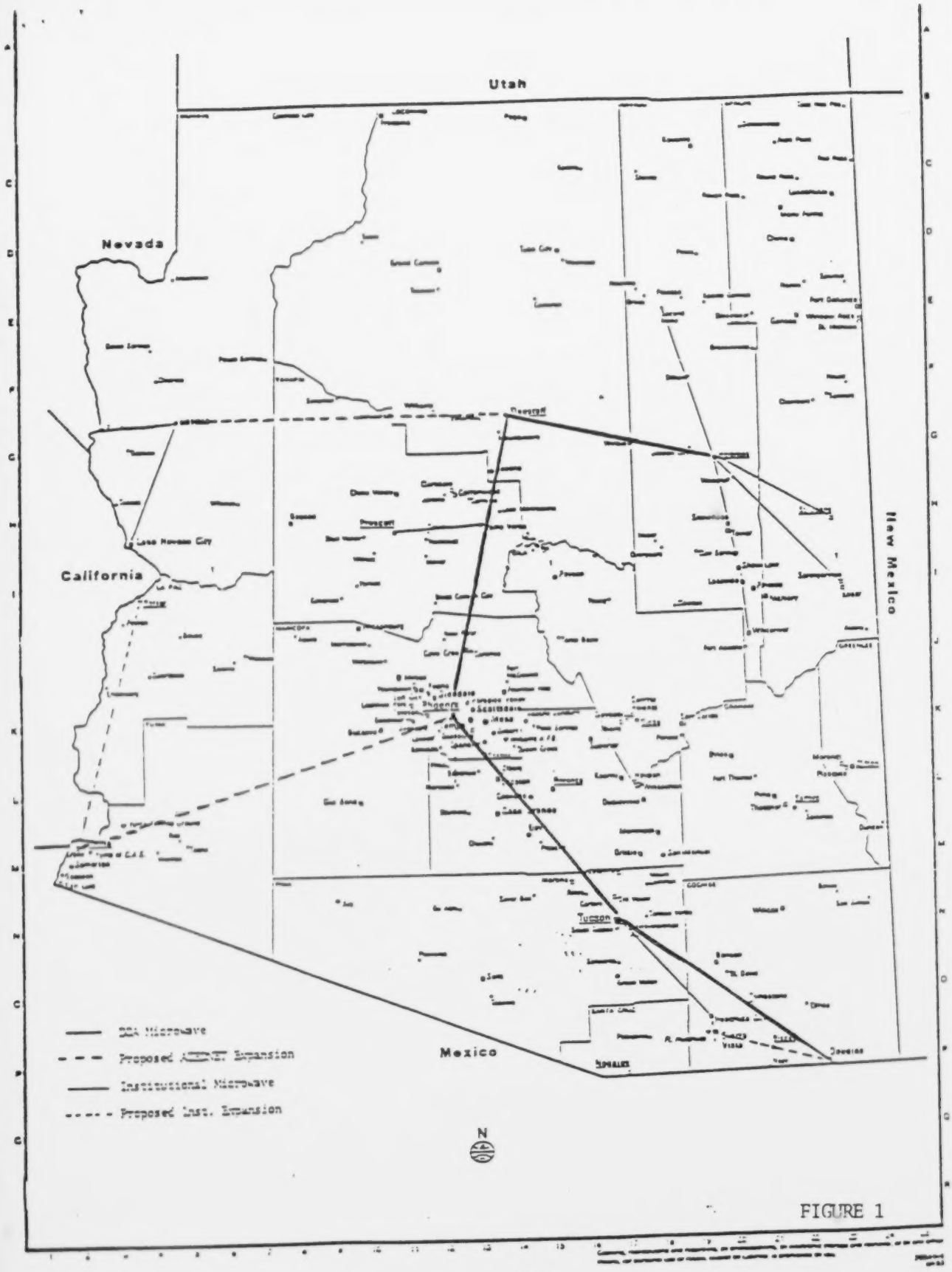

FIGURE 1

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